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BEAUMONT - PORT ARTHUR METROPOLITAN AREA AIR POLLUTANT EMISSION INVENTORY

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A summary is presented of the emission inventory for the Beaumont-Port Arthur Metropolitan Area. The report provides estimates of the present levels of air pollutant emissions and the status of their control. The pollutants which include sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides are delineated with respect to source type, season of the year, and geographical distribution within the area. The Study Area, which was chosen on the basis of the distribution of population and air pollution sources, consists of five counties surrounding the cities of Beaumont - Port Arthur and Orange. A grid coordinate system was used to show the geographical distribution of emissions within counties. All sources of emissions were classified into five categories: transportation, stationary fuel combustion, solid-waste disposal, industrial processes and evaporative losses.

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
ENVIRONMENTAL HEALTH SERVICE
National Air Pollution Control Administration
Durham, North Carolina
March 1970

PREFACE

This report, which presents the emission inventory for the Beaumont-Port Arthur Metropolitan Area, is another in a series of surveys outlining the sources and emissions of air pollutants for major metropolitan areas in the country. These surveys, conducted by the National Inventory of Air Pollutant Emissions and Control Branch of the National Air Pollution Control Administration, provide estimates of the present levels of air pollutant emissions and status of their control. The pollutants, which include sulfur oxides, particulates, carbon monoxide, hydrocarbons and nitrogen oxides, are delineated with respect to source type, season of the year and geographical distribution within the area. The general procedure for the surveys is based upon the rapid survey technique for estimating air pollutant emissions.[1] These reports are intended to serve as aids in the proposing of boundaries of Air Quality Control Regions, as directed by the Air Quality Act of 1967.

ACKNOWLEDGMENTS

Sincere gratitude is extended by the National Air Pollution Control Administration to the many individuals and companies who contributed to this air pollution emission inventory.

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INTRODUCTION

This report is a summary of the Beaumont-Port Arthur area air pollutant emission inventory conducted in October, 1969. Since all inventories are based upon a calendar year, the data and emission estimates presented are representative of 1968 and should be considered as indicating the conditions as existed during that year.

The Study Area, which was chosen on the basis of the distribution of population and air pollution sources, consists of five counties surrounding the cities of Beaumont-Port Arthur and Orange. This area covers approximately 4,100 square miles and had a 1968 population of 387,000.

A grid coordinate system was used to show the geographical distribution of emissions within counties. The Study Area was subdivided into 47 grid zones ranging in size from 25 square kilometers in the heavily populated and industrialized areas to 1,600 square kilometers in the rural areas.

All sources of emissions were classified into five categories--transportation, stationary fuel combustion, solid-waste disposal, industrial processes and evaporative losses. Each of these source categories was divided into two subgroups--point sources and area sources. Facilities, which emit large quantities of air pollutants, were considered individually as point sources, while the many remaining contributors such as motor vehicles, residential and commercial fuel users, small industries and on-site refuse burning equipment were considered collectiviely as area sources. For this report, 32 individual sources, which had emissions greater than 0.25 tons per average annual day for any pollutant, were classified as point sources.

Emissions were estimated by using various indicators such as fuel consumption, refuse burning rates, vehicle-miles, production data, control efficiencies and emission factors relating these indicators to emission rates.[2] These factors represent average emission rates for

a particular source category. Since individual sources have inherent differences that cannot always be taken into consideration, discrepancies between the actual and estimated emissions are more likely in individual sources than in the total emissions for a source category.

As in all emission surveys, the data presented are estimates and should not be interpreted as absolute values. The estimates are, in some cases, partial totals due to the lack of emission factors and production or consumption data. Despite these limitations, the estimates are of sufficient accuracy and validity to define the extent and distribution of air pollutant emissions in the Study Area.

SUMMARY

An estimated 1.0 million tons of five major pollutants are emitted annually in the Study Area. The breakdown of these emissions by type of pollutant and source category are summarized in Table 1. The following is a presentation of the relative contribution of different source categories.

Sulfur Oxides	1968 Total - 124,500	tons
	Industrial Processes	98%
	Transportation	1%
	Other	1%
Particulates	1968 Total - 24,700	tons
	Industrial Processes	73%
	Solid Waste Disposal	18%
	Transportation	6%
	Other	3%
Carbon Monoxide	1968 Total - 608,900	tons
	Industrial Processes	75%
	Road Vehicles	20%
	Other	5%
Hydrocarbons	1968 Total - 198,500	tons
	Industrial Processes	86%
	Transportation	6%
	Evaporative Losses	4%
	Other	4%
Nitrogen Oxides	1968 Total - 47,200	tons
	Industrial Processes	45%
	Industrial Fuel Use	29%
	Transportation	18%
	Solid Waste Disposal	6%
	Other	2%

TABLE 1 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE BEAUMONT-PORT ARTHUR STUDY AREA, 1968 (Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation					
Road Vehicles	610	1,050	123,500	9,850	7,200
Others	770	510	4,320	1,330	1,220
Subtotal	1,380	1,560	127,820	11,180	8,420
Stationary Fuel Combustion					
Industry	0	20	0	0	200
Steam-Electric	10	520	0	0	13,480
Residential	0	60	0	0	350
Commercial-Institutional	0	30	0	0	160
Subtotal	10	630	0	0	14,190
Solid Waste Disposal					
Incineration	110	530	2,350	40	160
Open Burning	240	3,830	20,340	7,180	2,630
Subtotal	350	4,360	22,690	7,220	2,790
Industrial Processes	122,780	18,130	458,350	171,540	21,800
Evaporative Losses	--	--	--	8,570	--
TOTAL ALL SOURCES	124,520	24,680	608,860	198,510	47,200

TABLE 1A SUMMARY OF AIR POLLUTANT EMISSIONS IN THE BEAUMONT-PORT ARTHUR STUDY AREA, 1968 (Tons/Year)*

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation					
Road Vehicles	550	950	112,010	8,930	6,530
Others	700	460	3,920	1,210	1,110
Subtotal	1,250	1,410	115,930	10,140	7,640
Stationary Fuel Combustion					
Industry	0	20	0	0	180
Steam-Electric	10	470	0	0	12,230
Residential	0	50	0	0	320
Commercial-Institutional	0	20	0	0	150
Subtotal	10	560	0	0	12,880
Solid Waste Disposal					
Incineration	100	480	2,130	40	150
Open Burning	220	3,470	18,450	6,510	2,390
Subtotal	320	3,950	20,580	6,550	2,540
Industrial Processes	111,360	16,440	415,720	155,590	19,770
Evaporative Losses	--	--	--	7,770	--
TOTAL ALL SOURCES	112,940	22,360	552,230	180,050	42,830

* Metric Ton = 1,000 kilograms

DESCRIPTION OF STUDY AREA

The Study Area for the Beaumont-Port Arthur Metropolitan Area Air Pollutant Emission Inventory is situated in the southeast corner of the State of Texas. As can be seen in Figure 1, the Study Area lies along the Gulf of Mexico and directly beside the Houston Air Quality Control Region.

Five counties have been included in the Study Area (Figure 2). Jefferson County, which is the most urbanized county in the Study Area, and Orange County have been designated the Beaumont-Port Arthur-Orange Standard Metropolitan Statistical Area (SMSA). Hardin County, Jasper County and Newton County, which are very lightly populated, were included in the Study Area to insure that all counties which may have a high rate of growth in future years would be surveyed.

The approximate 1968 population for the Study Area was 387,000. The rate of increase in population for the five county area has been lower than the nation's average increase. Between 1960 and 1968 the nation's population increased 10.9 percent, while the Beaumont-Port Arthur Study Area increased only 3.8 percent. The majority of the people live in the urbanized area of the Study Area. The urbanized area only covers 4 percent (153 square miles) of the 4,087 square mile Study Area. Table 2, which gives further demographic data by county, and Figure 3, which shows a population density map, will give the reader more information on the geographical distribution of the population.

TOPOGRAPHY

The Beaumont-Port Arthur Study Area lies on the Gulf Coastal Plain which makes up over 40 percent of Texas. The elevation of the Study Area rises from sea level to only a few hundred feet in upper sections of Jasper and Newton counties. The Sabine Bay, which forms the eastern border, and Nechis River have enabled Beaumont and Port Arthur to become Gulf Coast shipping centers.

Figure 1. Map of Beaumont - Port Arthur - Orange study area and surrounding states.

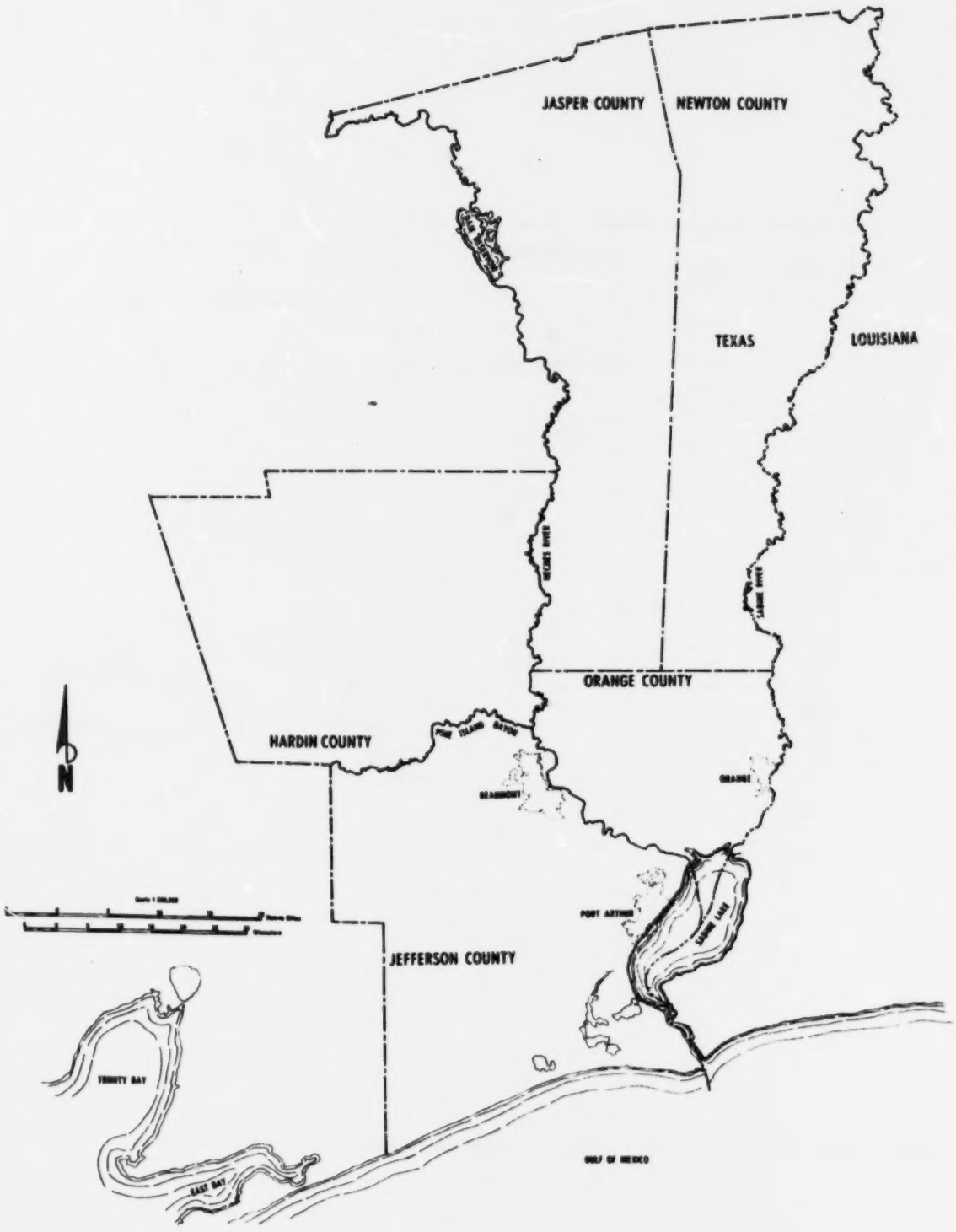

Figure 2. Detailed map of Beaumont-Port Arthur study area.

TABLE 2 AREA AND POPULATION CHARACTERISTICS FOR THE BEAUMONT-PORT ARTHUR STUDY AREA

County	Land Area (Sq. Mi.)	Population 1960	Population 1968	Population Density (1968)
Hardin County	897	24,600	32,300	36
Jasper County	927	22,100	28,800	31
Jefferson County	951	245,700	247,100	260
Newton County	953	10,400	11,100	12
Orange County	359	60,400	67,700	189
STUDY AREA	4,087	363,200	387,000	95

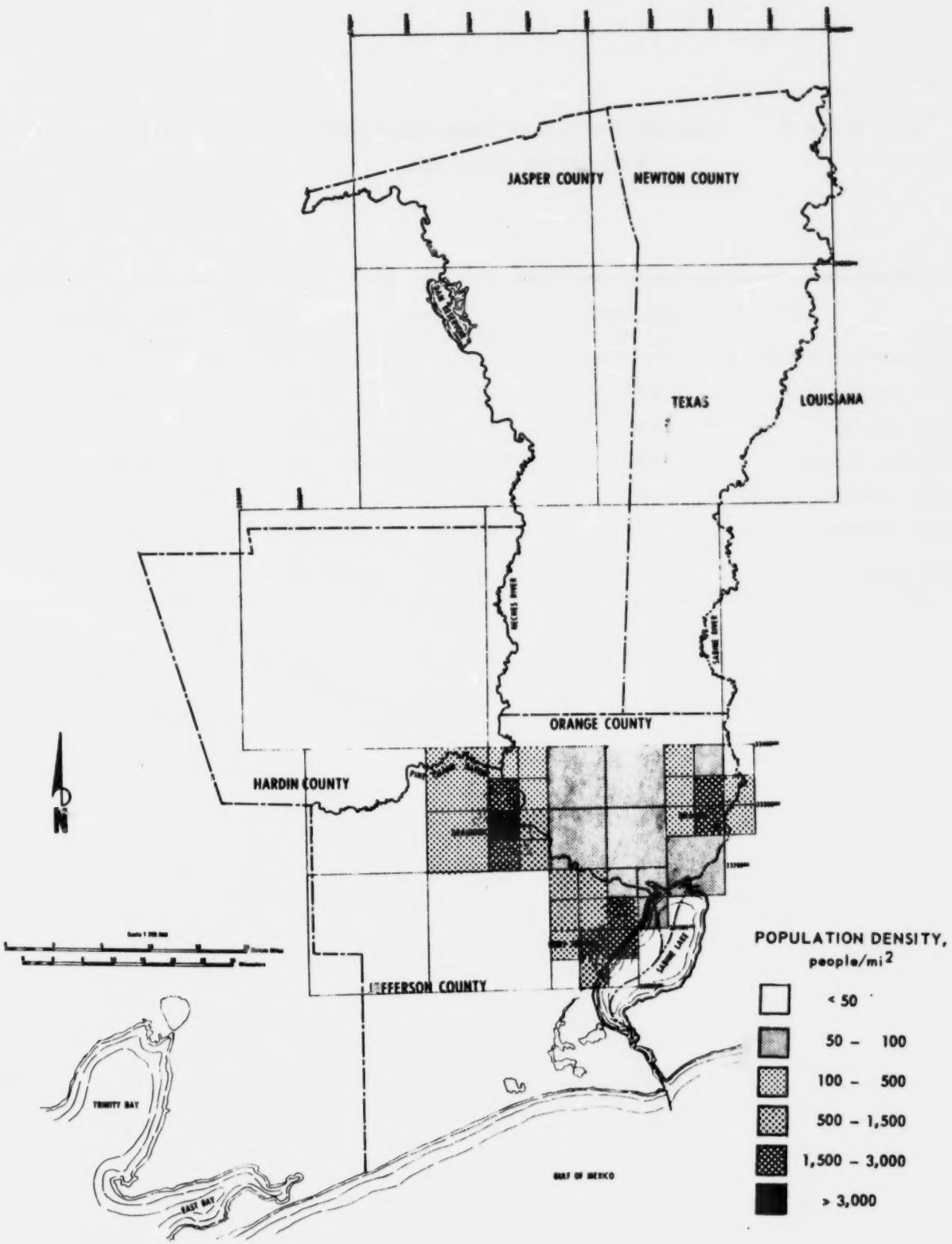

Figure 3. Population density map for Beaumont-Port Arthur study area, 1968.

CLIMATOLOGY

The climate is predominantly marine. The numerous small streams and the nearness to the Gulf of Mexico and Sabine Bay cause the development of both ground and advective fog. Prevailing winds are from the southeast and south, except in the winter months when frequent passages of high pressure areas bring prevailing northerly winds.

Temperatures are moderated by the influence of winds from the Gulf, which results in mild winters and relatively cool summer nights. Another effect of the nearness of the Gulf is abundant rainfall. The rainfall is evenly distributed throughout the year with total precipitative ranging from 30 and 60 inches.

INDUSTRIAL FACTORS

The Beaumont-Port Arthur-Orange area is one of the largest petroleum petrochemical centers in the nation. Five major oil companies and numerous chemical companies have facilities in the Study Area. Other industries include the agriculture industries and lumber and pulp industry. Table 3 shows the number and type of industries located in the Study Area.

TABLE 3 NUMBER OF INDUSTRIAL ESTABLISHMENTS IN BEAUMONT-PORT ARTHUR STUDY AREA, 1960

Industry	Hardin County	Jasper County	Jefferson County	Newton County	Orange County
Food and Tobacco	--	3	19	--	1
Textiles	--	--	--	--	--
Paper and Printing	1	--	5	--	3
Chemicals	1	--	21	--	9
Lumber and Wood	6	5	3	3	1
Stone and Gravel	--	--	5	--	1
Primary and Intermediate Metals	--	--	15	--	2
Electrical Machinery	1	--	4	--	--
Transportation and Ordinance	--	--	4	--	1
Instruments and Miscellaneous	--	--	2	--	1

GRID COORDINATE SYSTEM

A grid coordinate system, based on the Universal Transverse Mercator Projection (UTM), was used in the Beaumont-Port Arthur Study Area to indicate the geographical distribution of emissions. A map showing the grid coordinate system is presented in Figure 4.

An evaluation of the available coordinate systems was completed before choosing the UTM system to present emissions in this series of emission inventories. The systems evaluated were the State Plane system, the Longitude-Latitude system and the UTM system. Although each of the systems had valuable qualities, the use of the UTM coordinate system was felt to completely meet the requirements of these emission inventories.

Two primary requirements of the grid coordinate system were used to evaluate each system. One of the requirements was that the grid coordinate system had to have square grid zones, since the data were to be used in meteorological dispersion models. The grid zones, which the UTM system and most of the State Plane systems project, are always square, but the longitude-latitude system projects grid zones that become skewed as the zones become further from the equator. The other quality the grid coordinate system had to possess was consistency. Each emission inventory should be conducted on a grid coordinate system which uses the same reference point throughout the Study Area. Since some air pollutant inventories would include areas in two or more states, the State Plane systems could not be used. However, since the UTM system, as well as the longitude-latitude system, is not referenced to points in individual states, it is not influenced by jurisdiction boundaries. The UTM system was chosen since it was the only coordinate system which could project square grid zones over any Study Area using a common reference point.

The Universal Transverse Mercator Projection is based upon the metric system. Each north-south and east-west grid lines, as illustrated in Figure 4, is identified by a coordinate number expressed in meters.

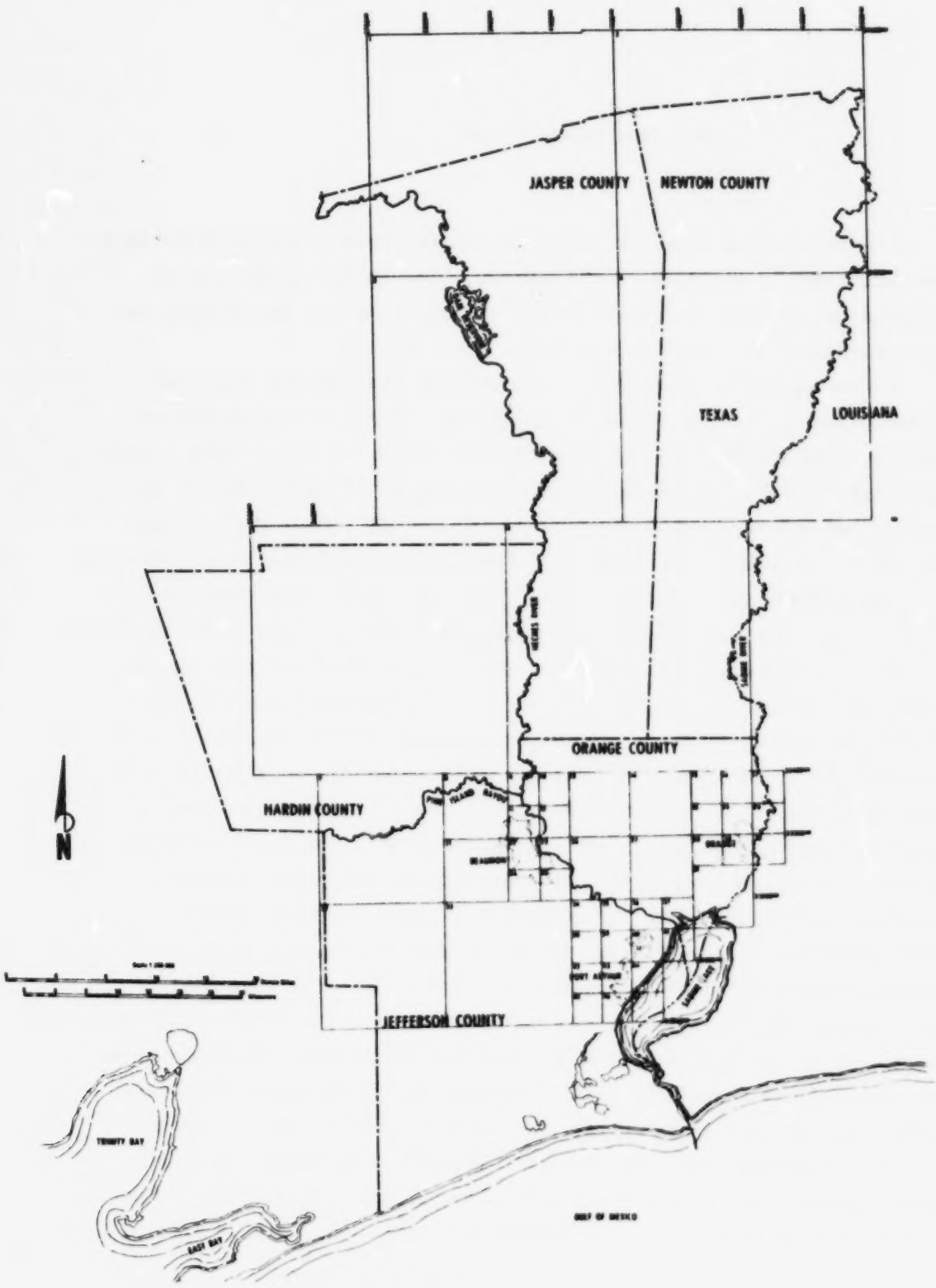

Figure 4. Grid coordinate system for Beaumont-Port Arthur study area.

Each point source and grid, using the geographical center of the grid, is identified by a horizontal and vertical coordinate to the nearest 100 meters.

Grid zones of different sizes are used in the grid coordinate system to allow a satisfactory definition of the geographical gradation of emissions and to limit the number of grid zones. Since the majority of emissions is usually concentrated in the populated and industrialized portions of a Study Area, smaller grids are placed over these areas to allow the grid coordinate system to reflect the changes of emissions over short distances. Grid zones smaller than the 25 kilometer grid zones used in this report are not usually warranted because of the inherent inaccuracies in the data. Larger grid zones are used in the rural portions, because a smaller portion of the total emissions usually occurs in lightly populated areas.

EMISSIONS BY CATEGORY

STATIONARY FUEL COMBUSTION

The stationary fuel combustion source category is concerned with four primary sources: industrial, steam-electric, residential and commercial-institutional. Usually, four fuels are considered in the source category, but in the Beaumont-Port Arthur only one, natural gas, was burned in sufficient quantity to be considered.

Steam-Electric

METHODOLOGY: There are two major power plants in the Study Area. Fuel consumption data for the two plants were obtained from the Federal Power Commission. The summer to winter fuel burning ratios found in the Houston Study Area's power plants were also used for the Beaumont-Port Arthur power plants.

RESULTS: The fuel consumed by the two power plants caused over 13,000 tons of nitrogen oxides to be emitted. This nitrogen oxide accounts for almost a third of the total nitrogen oxide in the Study Area. The amounts emitted of the other pollutants were negligible except for the 500 tons of particulates.

Industry

METHODOLOGY: Natural gas data for the industrial sources were supplied for each county by the Texas Environmental Health Section. No fuel consumption data were received on any individual sources.

The emissions caused by this fuel, were proportioned into grids using a map distributed by the Gulf Oil Company. The map locates all major industries in the Study Area.

RESULTS: Emissions caused by this source can be considered negligible in all pollutants. Only 200 tons of nitrogen oxides were emitted by industrial fuel consumption during 1968.

TABLE 4 SUMMARY OF FUEL COMBUSTION IN BEAUMONT-PORT ARTHUR STUDY AREA, 1968

County	Residential	Commercial-Institutional	Industrial	Steam-Electric
Natural Gas (10^6 cu. ft./year)				
Hardin County	100	100	100	0
Jasper County	200	100	300	0
Jefferson County	4,900	2,000	1,300	23,600
Newton County	0	0	0	0
Orange County	800	500	100	45,500
Distillate Fuel Oil (1,000 gal/year)				
Hardin County	0	0	0	0
Jasper County	0	0	0	0
Jefferson County	100	0	0	0
Newton County	0	0	0	0
Orange County	0	0	0	0
Coal (tons/year)				
Hardin County	0	0	0	0
Jasper County	0	0	0	0
Jefferson County	0	0	0	0
Newton County	0	0	0	0
Orange County	0	0	0	0

TABLE 5 CHEMICAL ANALYSIS OF FUELS IN THE BEAUMONT-PORT ARTHUR STUDY AREA

	% Sulfur	% Ash	% Volatile Material
Coal	1.0	9.0	30.7
Residual Fuel Oil	1.97		
Distillate Fuel Oil	0.18		
Natural Gas	0.0008		

TABLE 6 AIR POLLUTANT EMISSIONS FROM STATIONARY FUEL COMBUSTION IN THE BEAUMONT-PORT ARTHUR STUDY AREA, 1968 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Natural Gas					
Industrial	0	20	0	0	200
Steam-Electric	10	520	0	0	13,480
Residential	0	60	0	0	350
Commercial-Institutional	0	30	0	0	160
Subtotal	10	630	0	0	14,190
Fuel Oil					
Industrial	0	0	0	0	0
Steam-Electric	0	0	0	0	0
Residential	0	0	0	0	0
Commercial-Institutional	0	0	0	0	0
Subtotal	0	0	0	0	0
Coal					
Industrial	0	0	0	0	0
Steam-Electric	0	0	0	0	0
Residential	0	0	0	0	0
Commercial-Institutional	0	0	0	0	0
Subtotal	0	0	0	0	0
STUDY AREA	10	630	0	0	14,190

Residential and Commercial-Institutional

METHODOLOGY: Data on these two source categories were also received on a county basis from the Texas Environmental Health Section.

Both categories were proportioned into grid zones using population. The population distribution was determined by using census tract data and other available information.[3,4]

RESULTS: Approximately 350 tons of nitrogen oxide was emitted by residential sources and about 160 tons by commercial sources. The amount emitted of the other four pollutants was very small.

TRANSPORTATION

The transportation source category is concerned with all mobile sources. Sources in this category include road vehicles (gasoline and diesel powered), aircraft, vessels, and railroads.

Road Vehicles

METHODOLOGY: Total vehicle activity in each county was estimated by using gasoline consumption figures obtained from the United States Department of Commerce.[5] These 1963 fuel consumption figures were updated to 1968 by using state vehicle mile data obtained from the United States Department of Transportation.[6]

In order to better proportion the road vehicle's emissions, the vehicle mile activity from major highways was measured into grids using traffic flow maps. After the majority of the vehicle miles had been placed into grid zones, the remaining vehicle miles were proportioned by population. The vehicle miles contributed to diesels were proportioned with the flow maps alone.

RESULTS: Motor vehicle activity was found to be heaviest in Jefferson and Orange counties, Table 7. Jefferson County alone had over 65 percent of the traffic in the Study Area.

TABLE 7 VEHICLE MILES OF TRAVEL FOR ROAD VEHICLES IN THE BEAUMONT-PORT ARTHUR STUDY AREA, 1968 (1,000 v.m./yr.)

County	Gasoline Powered	Diesel Powered	Total
Hardin County	98,800	2,750	101,550
Jasper County	93,800	2,650	96,450
Jefferson County	1,024,000	28,650	1,052,650
Newton County	47,500	1,350	48,850
Orange County	213,000	5,950	218,950
STUDY AREA	1,477,100	41,350	1,518,450

Motor vehicles were the number one contributor of air pollutants in the transportation source category. When compared to other source categories, road vehicles also were major contributors to the total air pollutants emitted. Road vehicles are the second largest emitters of sulfur oxides, carbon monoxides, and hydrocarbons. They are third for the other two pollutants.

Aircraft

METHODOLOGY: Data were obtained on the Jefferson County Airport from personnel communications with the flight controlers at the airport.

RESULTS: Emissions were estimated for four of the five pollutants. Sulfur oxide emissions were not estimated because emission factors were not available.

The majority of the emissions caused at the airport are emitted by the numerous piston powered aircraft. Piston powered aircraft emitted 99 percent of the carbon monoxide, 96 percent of the hydrocarbons, and 90 percent of the nitrogen oxides.

Railroads

METHODOLOGY: Information on the fuel consumption of railroads for the State of Texas was obtained from an American Petroleum Institute publication.[7] State totals were proportioned into the individual counties on the basis of population. The county totals were further proportioned into grid zones by evenly distributing the fuel into all grid zones which had railroad activity.

RESULTS: Several hundred tons of hydrocarbons, particulates and nitrogen oxide were emitted in the Study Area.

Vessels

METHODOLOGY: Data on vessels were obtained through personnel communications with the United States Coast Guard facilities. Emission estimates were made only on ships weighing 10,000 tons or more.

TABLE 8 AIR TRAFFIC ACTIVITY AT JEFFERSON COUNTY AIRPORT
1968, (Flights/Year)

	Number of Engines			
	1 Engine	2 Engines	3 Engines	4 Engines
Conventional Jets	0	1,600	0	0
Fan Jets	0	1,800	0	0
Turbo-prop	0	5,400	0	0
Piston	490	16,400	0	0

TABLE 9 AIR POLLUTANT EMISSIONS FROM TRANSPORTATION SOURCES IN THE BEAUMONT-PORT ARTHUR STUDY AREA, 1968 (Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Road Vehicles					
Gasoline Powered	440	590	123,230	9,290	6,270
Diesel Powered	170	560	250	570	920
Evaporative Losses	--	--	--	6,200	--
Subtotal	610	1,150	123,480	16,060	7,190
Aircraft					
Jet	0	20	20	20	10
Piston	0	20	4,060	780	190
Turboprop	0	0	10	0	10
Subtotal	0	40	4,090	800	210
Vessels	620	40	0	0	160
Railroads	150	420	230	530	860
STUDY AREA	1,380	1,650	127,800	17,390	8,420

Approximately 125 ships per month use the Port Arthur port and 125 ships per month use the Beaumont port.

RESULTS: The residual fuel oil burned by the vessels accounts for 45 percent of the sulfur oxides attributable to transportation sources. The other pollutants emitted are either small or negligible.

SOLID WASTE

The solid waste source category is concerned with the air pollutant emissions caused by refuse disposal. Refuse includes not only the municipal refuse, but also refuse generated by commercial and industrial facilities. The primary means of disposing of refuse are: landfills, dumps, incinerators, and on-site burning. Only open burning dumps, incinerators and on-site burning are considered air pollutant sources.

METHODOLOGY: The total tons of refuse generated in the Salt Lake City area was determined by using the national generation rate of 10 pounds per person per day.[8] This total includes municipal, commercial and industrial refuse. In order to determine the amount of refuse being disposed of by each means of disposal, data was collected on all landfills, and dumps in the Study Area. The amount of refuse being disposed of by on-site incineration and on-site burning was determined with national averages.[10] These data were assembled into a refuse balance (Table 10).

The proportioning of the county totals into grids was done in three steps. The first was the accurate locating of all open burning dumps which had been surveyed. Then the on-site burning and on-site incineration were distributed into grids on the basis of population.

RESULTS: Emissions caused by the open burning of refuse, contributed most of the emissions in the solid waste source category (Table 11). About twice as much emissions were caused by the open burning dumps than were caused by on-site burning.

TABLE 10 SOLID WASTE DISPOSAL BALANCE FOR THE BEAUMONT-PORT ARTHUR STUDY AREA
1968, (Tons/Year)

County	Total Generation	Incineration		Landfill	Dump*	On-Site Burning
		Municipal	On-Site			
Hardin County	59,000	--	9,000	--	39,000	11,000
Jasper County	53,000	--	8,000	--	19,000	26,000
Jefferson County	450,000	--	68,000	--	168,000	214,000
Newton County	20,000	--	3,000	--	4,000	13,000
Orange County	124,000	--	19,000	--	41,000	64,000
STUDY AREA	706,000	--	107,000	--	271,000	328,000

*Approximately 56 percent of refuse is burned.

TABLE 11 AIR POLLUTANT EMISSIONS FROM SOLID WASTE DISPOSAL IN THE BEAUMONT-PORT ARTHUR STUDY AREA, 1968 (Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Incineration					
Municipal	0	0	0	0	0
On-Site	110	530	2,350	40	160
Subtotal	110	530	2,350	40	160
Open Burning					
Dumps	160	2,620	13,940	4,920	1,800
On-Site	70	1,200	6,400	2,260	830
Subtotal	230	3,820	20,340	7,180	2,630
STUDY AREA	340	4,350	22,690	7,220	2,790

The Solid waste category when compared to the other emission sources in the Study Area ranked third or fourth in all pollutants.

INDUSTRIAL PROCESSES

The industrial process category is concerned with all industrial air pollutant sources other than the burning of fuel or the disposal of refuse. That portion of fuel which is used for process heating is included in the fuel combustion source category.

METHODOLOGY: Information concerning industrial processes was gathered on an individual plant basis. Each company was contacted by the Texas Environmental Health Section and asked to supply the estimated emissions from their facility. Because of the cooperation in the Study Area only one engineering estimate was made. That estimate determined the amount of carbon monoxide being emitted by a petroleum refinery which did not have a waste heat boiler on its fluid catalytic unit. A standard air pollutant emission factor published by the Department of Health Education, and Welfare was used.[2]

RESULTS: The industrial processes source category was the major emitter of all pollutants. The amount of emissions attributed to each industrial category is found in Table 12.

EVAPORATIVE LOSSES

The evaporative losses source category is concerned with emissions of hydrocarbons. The three primary sources studied in this category were dry cleaning, the automobile, and gasoline marketing. There are a multitude of other domestic and commercial sources of evaporative losses, but these were not included because emission factors were not available.

METHODOLOGY: Dry cleaning emissions and gasoline emissions were estimated using factors based upon population.[2] The emissions were also proportioned into counties and grids using population. Evaporative

TABLE 12 AIR POLLUTANT EMISSIONS FROM INDUSTRIAL PROCESSES IN THE BEAUMONT-PORT ARTHUR STUDY AREA, 1968 (Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbon	Nitrogen Oxides
Chemical Processes	4,820	80	6,360	22,950	11,780
Petroleum Refining	115,810	8,920	451,870	146,800	9,740
Synthetic Rubber	0	50	120	1,780	280
Wood Products	1,070	5,800	0	0	0
Coke Calcining	1,080	3,280	0	0	0
STUDY AREA	122,780	18,130	458,350	171,530	21,800

losses by the automobile were estimated using vehicle mile activity. These emissions were distributed in the same manner that the balance of the automobile emissions were.

No estimates were made on the evaporative losses due to the petroleum storage and handling in the Study Area because of the limited time available for the emissions inventory.

RESULTS: The automobile was the largest single source in the evaporative losses category with 6,200 tons of hydrocarbons (Table 13). Dry cleaning and gasoline storage and handling contributed 750 tons and 1,620 tons of hydrocarbons respectively. In the Study Area evaporative losses surveyed accounted for only 4 percent of all hydrocarbons emitted.

TABLE 13 HYDROCARBON EMISSIONS FROM EVAPORATIVE LOSSES IN THE BEAUMONT-PORT ARTHUR STUDY AREA, 1968 (Tons/Year)

Dry Cleaning	750
Gasoline Marketing	1,620
Road Vehicles	6,200
STUDY AREA	8,570

EMISSIONS BY JURISDICTION

The previous section presented air pollutant emissions by source category. In order to show the contribution of each county to the air pollution in the Study Area, their emissions are summarized in Tables 14 through 20.

TABLE 14 SUMMARY OF AIR POLLUTANT EMISSIONS IN HARDIN COUNTY
1968 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Road Vehicles	40	70	8,280	660	480
Others	10	30	20	40	70
Subtotal	50	100	8,300	700	550
Stationary Fuel Combustion					
Industry	0	0	0	0	20
Steam-Electric	0	0	0	0	0
Residential	0	0	0	0	10
Commercial-Institutional	0	0	0	0	0
Subtotal	0	0	0	0	30
Solid Waste Disposal					
Incineration	10	50	200	0	10
Open Burning	10	90	480	170	60
Subtotal	20	140	680	170	70
Industrial Processes	0	0	0	0	0
Evaporative Losses	--	--	--	590	--
TOTAL ALL SOURCES	70	240	8,980	1,460	650

TABLE 15 SUMMARY OF AIR POLLUTANT EMISSIONS IN JASPER COUNTY
1968 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Road Vehicles	40	70	7,840	630	460
Others	10	30	20	40	60
Subtotal	50	100	7,860	670	520
Stationary Fuel Combustion					
Industry	0	0	0	0	30
Steam-Electric	0	0	0	0	0
Residential	0	0	0	0	10
Commercial-Institutional	0	0	0	0	10
Subtotal	0	0	0	0	50
Solid Waste Disposal					
Incineration	10	40	180	0	10
Open Burning	20	310	1,660	590	220
Subtotal	30	350	1,840	590	230
Industrial Processes	500	3,430	0	0	0
Evaporative Losses	--	--	--	550	--
TOTAL ALL SOURCES	580	3,880	9,700	1,810	800

TABLE 16 SUMMARY OF AIR POLLUTANT EMISSIONS IN JEFFERSON COUNTY
1968 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Road Vehicles	420	730	85,600	6,830	4,990
Others	720	360	4,240	1,140	910
Subtotal	1,140	1,090	89,840	7,970	5,900
Stationary Fuel Combustion					
Industry	0	10	0	0	140
Steam-Electric	0	180	0	0	4,610
Residential	0	50	0	0	290
Commercial-Institutional	0	20	0	0	120
Subtotal	0	260	0	0	5,160
Solid Waste Disposal					
Incineration	70	340	1,500	30	100
Open Burning	160	2,640	14,000	4,940	1,810
Subtotal	230	2,980	15,500	4,970	1,910
Industrial Processes	120,710	12,270	387,250	160,960	12,420
Evaporative Losses	--	--	--	5,900	--
TOTAL ALL SOURCES	122,080	16,600	492,590	179,800	25,390

TABLE 17 SUMMARY OF AIR POLLUTANT EMISSIONS IN NEWTON COUNTY
1968 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Road Vehicles	20	30	3,950	320	230
Others	0	10	10	10	20
Subtotal	20	40	3,960	330	250
Stationary Fuel Combustion					
Industry	0	0	0	0	0
Steam-Electric	0	0	0	0	0
Residential	0	0	0	0	0
Commercial-Institutional	0	0	0	0	0
Subtotal	0	0	0	0	0
Solid Waste Disposal					
Incineration	0	10	70	0	0
Open Burning	10	140	730	260	90
Subtotal	10	150	800	260	90
Industrial Processes	0	0	0	0	0
Evaporative Losses	--	--	--	270	--
TOTAL ALL SOURCES	30	190	4,760	860	340

TABLE 18 SUMMARY OF AIR POLLUTANT EMISSIONS IN ORANGE COUNTY
1968 (Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Road Vehicles	90	150	17,810	1,420	1,040
Others	30	70	40	90	150
Subtotal	120	220	17,850	1,510	1,190
Stationary Fuel Combustion					
Industry	0	0	0	0	10
Steam-Electric	10	340	0	0	8,870
Residential	0	10	0	0	40
Commercial-Institutional	0	0	0	0	30
Subtotal	10	350	0	0	8,950
Solid Waste Disposal					
Incineration	20	100	420	10	30
Open Burning	40	650	3,460	1,220	450
Subtotal	60	750	3,880	1,230	480
Industrial Processes	1,570	2,430	71,100	10,580	9,390
Evaporative Losses	--	--	--	1,260	--
TOTAL ALL SOURCES	1,760	3,750	92,830	14,580	20,010

EMISSIONS BY GRID

For the purpose of defining the geographical variation in air pollutant emissions in the Study Area, the emissions were apportionned onto a grid coordinate system. The emissions were divided into two source groups--point sources and area sources. Thirty-two point sources are presented individually in Table 19. Each of these point sources emitted more than 0.25 tons per day of a pollutant. The approximate location of these point sources are shown in Figure 5. Area sources which made up the balance of emissions have not been presented separately, but have been combined with the point source emissions and presented with emissions from all sources in Table 20.

In order to present a visual representation of the emissions of pollutants by grid, emission density maps have been prepared. Emission densities were obtained by summing the annual area and point source emissions for each grid and dividing this total by the land area of the grid. Figures 6 through 10 show the variation in emission densities for the respective grids throughout the Study Area.

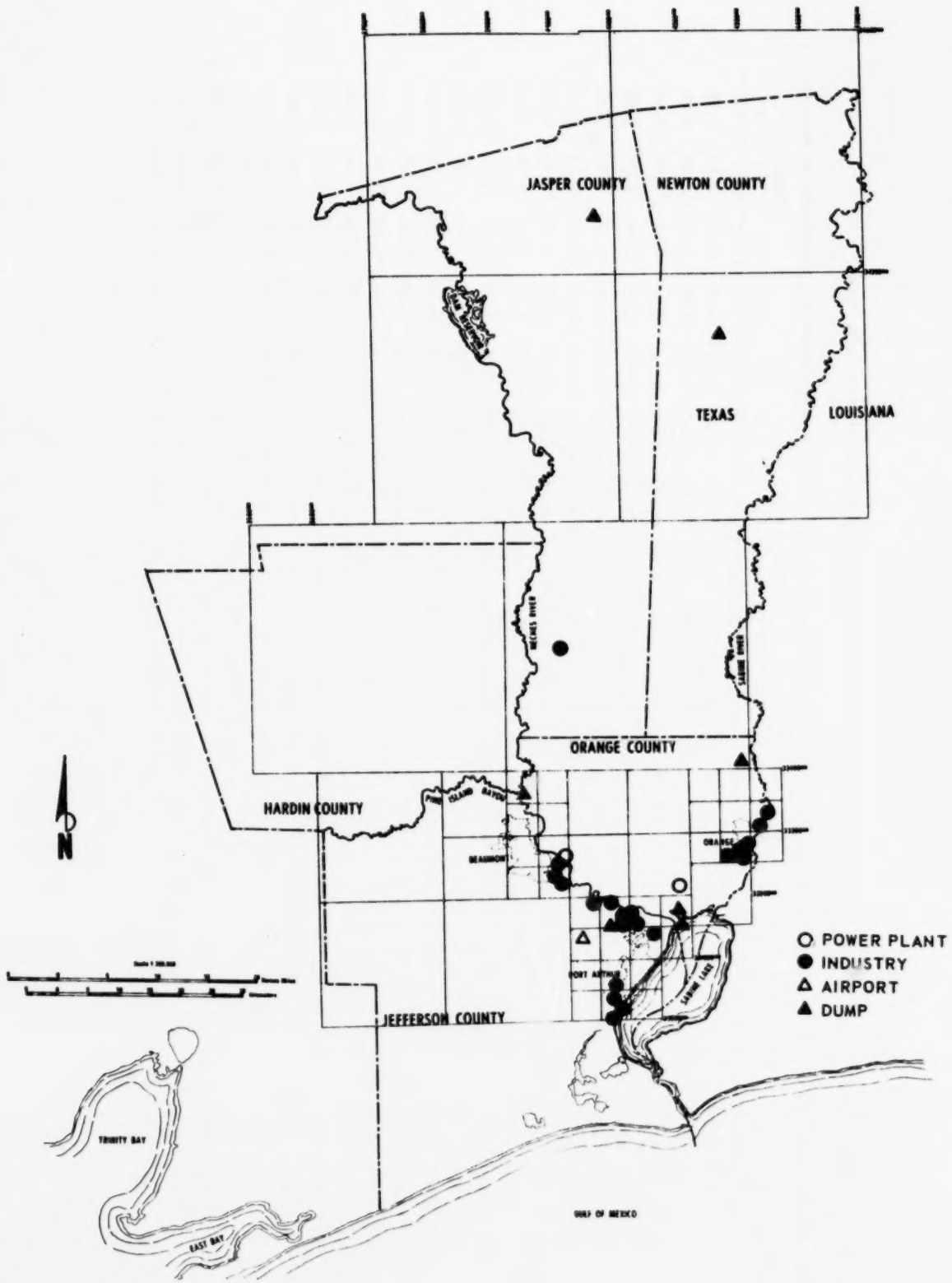

Figure 5. Point source location map for Beaumont-Port Arthur study area, 1968.

TABLE 19 SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES FOR THE BEAUMONT-PORT ARTHUR STUDY AREA, 1968

Source Category	Grid	HC	VC	SOx			PART.			CO			HC			NOx		
				S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
Dump	1	4070	34280	0.0	0.0	0.0	0.21	0.21	0.21	1.16	1.16	1.16	0.41	0.41	0.41	0.15	0.15	0.15
Dump	4	4250	34100	0.0	0.0	0.0	0.08	0.08	0.08	0.46	0.46	0.46	0.16	0.16	0.16	0.06	0.06	0.06
Industry	6	3980	33600	1.3	1.3	1.3	9.39	9.39	9.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dump	6	4280	33425	0.0	0.0	0.0	0.05	0.05	0.05	0.29	0.29	0.29	0.10	0.10	0.10	0.03	0.03	0.03
Dump	9	3925	33370	0.0	0.0	0.0	0.21	0.21	0.21	0.16	0.16	0.16	0.41	0.41	0.41	0.15	0.15	0.15
Industry	20	4327	33325	0.0	0.0	0.0	0.17	0.17	0.17	180.99	179.99	179.99	13.69	13.69	13.69	0.15	0.15	0.15
Industry	20	4332	33335	1.5	1.5	1.5	6.48	6.48	6.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industry	23	3990	33260	0.0	0.0	0.0	0.21	0.21	0.21	1.35	1.35	1.35	2.45	2.45	2.45	0.00	0.00	0.00
Power Plant	23	3990	33264	0.0	0.0	0.0	0.78	0.39	0.48	0.00	0.00	0.00	0.00	0.00	0.00	20.47	10.23	12.62
Industry	25	3970	33240	5.3	5.3	5.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industry	25	3976	33225	4.7	4.7	4.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Power Plant	27	4175	33220	0.0	0.0	0.0	1.51	0.75	0.93	0.00	0.00	0.00	0.00	0.00	0.00	39.41	19.70	24.29
Industry	29	4298	33271	2.7	2.7	2.7	0.00	0.00	0.00	5.47	5.47	5.47	13.69	13.69	13.69	21.89	21.89	21.89
Industry	29	255	33260	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.46	2.46	2.46
Industry	29	4296	33268	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.52	0.52	0.70	0.70	0.70
Industry	29	4280	33270	0.0	0.0	0.0	0.00	0.00	0.00	9.30	9.30	9.30	1.03	1.03	1.03	0.47	0.47	0.47
Industry	34	4030	33195	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	35.79	35.79	35.79	0.00	0.00	0.00
Industry	35	4057	33187	21.4	21.4	21.4	2.00	2.00	2.00	0.00	0.00	0.00	43.09	43.09	43.09	1.71	1.71	1.71
Industry	35	4090	33165	0.0	0.0	0.0	0.05	0.05	0.05	0.17	0.17	0.17	1.18	1.18	1.18	0.00	0.00	0.00
Industry	35	4084	33168	0.0	0.0	0.0	0.06	0.06	0.06	0.13	0.13	0.13	3.15	3.15	3.15	0.05	0.05	0.05
Industry	35	4084	33163	0.1	0.1	0.1	0.00	0.00	0.00	1.28	1.28	1.28	1.65	1.65	1.65	7.41	7.41	7.41

TABLE 19 SUMMARY OF EMISSIONS FROM POINT SOURCES (cont.)

Source Category	Grid	HC	VC	SOx			PART.			CO			HC			NOx		
				S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
Dump	35	4075	33154	0.0	0.0	0.0	1.31	1.31	1.31	6.98	6.98	6.98	2.46	2.46	2.46	0.90	0.90	0.90
Industry	36	4101	33154	0.1	0.1	0.1	0.00	0.00	0.00	0.00	0.00	0.00	8.21	8.21	8.21	0.00	0.00	0.00
Dump	37	4165	33154	0.0	0.0	0.0	1.21	1.21	1.21	6.42	6.42	6.42	2.26	2.26	2.26	0.83	0.83	0.83
Dump	37	4175	33170	0.0	0.0	0.0	0.10	0.10	0.10	0.58	0.58	0.58	0.20	0.20	0.20	0.07	0.07	0.07
Industry	35	4095	33176	0.1	0.1	0.1	0.00	0.00	0.00	0.00	0.00	0.00	13.49	13.49	13.49	0.70	0.70	0.70
Airport	38	4014	33136	0.0	0.0	0.0	0.10	0.10	0.10	11.19	11.19	11.19	2.18	2.18	2.18	0.56	0.56	0.56
Industry	40	4141	33145	60.2	60.2	60.2	1.17	1.17	1.17	487.99	487.99	487.99	13.99	13.99	13.99	2.46	2.46	2.46
Industry	43	4075	33058	152.9	152.9	152.9	5.47	5.47	5.47	569.99	569.99	569.99	41.09	41.09	41.09	17.79	17.79	17.79
Industry	46	4064	33036	81.2	81.2	81.2	15.59	15.59	15.59	0.00	0.00	0.00	207.99	207.99	207.99	3.45	3.45	3.45
Industry	46	4075	330 5	1.0	1.0	1.0	0.00	0.00	0.00	0.00	0.00	0.00	68.79	68.79	68.79	0.36	0.36	0.36
Industry	46	4073	330 5	2.9	2.9	2.9	8.98	8.98	8.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 20 SUMMARY OF AIR POLLUTANT EMISSIONS FROM ALL SOURCES (Tons/Year)

Grid	Land Area (Sq. Mi.)	SOx			PART.			CO			HC			NOx		
		S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
1	617.7	0.1	0.1	0.1	0.5	0.5	0.5	7.0	6.4	6.7	1.5	1.4	1.4	0.6	0.6	0.6
2	617.7	0.0	0.0	0.0	0.1	0.1	0.1	2.5	2.2	2.3	0.4	0.4	0.4	0.2	0.2	0.2
3	617.7	0.1	0.1	0.1	0.3	0.3	0.3	7.3	6.5	6.9	1.3	1.2	1.2	0.5	0.5	0.5
4	617.7	0.1	0.1	0.1	0.7	0.7	0.7	16.2	14.6	15.3	2.9	2.7	2.8	1.2	1.2	1.2
5	617.7	0.2	0.1	0.2	0.6	0.5	0.5	20.6	18.3	19.4	3.3	3.0	3.2	1.5	1.4	1.5
6	617.7	1.5	1.5	1.5	9.8	9.8	9.8	10.7	9.6	10.1	1.9	1.8	1.8	0.8	0.8	0.8
7	154.4	0.1	0.1	0.1	0.2	0.2	0.2	5.0	4.5	4.7	0.9	0.8	0.8	0.5	0.5	0.5
8	38.6	0.1	0.1	0.1	0.4	0.4	0.4	13.6	12.1	12.8	2.3	2.1	2.2	1.0	1.0	1.0
9	9.6	0.0	0.0	0.0	0.3	0.3	0.3	2.4	2.3	2.3	0.6	0.6	0.6	0.2	0.2	0.2
10	9.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.9	1.0	0.2	0.2	0.2	0.1	0.1	0.1
11	9.6	0.2	0.2	0.2	0.9	0.9	0.9	29.5	26.3	27.8	4.9	4.5	4.7	2.0	2.0	2.0
12	9.6	0.0	0.0	0.0	0.1	0.1	0.1	3.9	3.3	3.6	0.7	0.6	0.6	0.3	0.3	0.3
13	38.6	0.0	0.0	0.0	0.1	0.1	0.1	2.1	1.9	2.0	0.4	0.3	0.4	0.1	0.1	0.1
14	38.6	0.0	0.0	0.0	0.1	0.1	0.1	1.7	1.6	1.6	0.3	0.3	0.3	0.2	0.2	0.2
15	9.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.9	0.9	0.2	0.2	0.2	0.1	0.1	0.1
16	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.6	0.1	0.1	0.1	0.0	0.0	0.0
17	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.1	0.1	0.1	0.0	0.0	0.0
18	9.6	0.0	0.0	0.0	0.1	0.1	0.1	2.1	1.9	2.0	0.4	0.4	0.4	0.2	0.2	0.2
19	9.6	0.1	0.1	0.1	0.6	0.6	0.6	15.1	13.5	14.2	2.6	2.4	2.5	1.1	1.1	1.1
20	9.6	1.6	1.6	1.6	6.8	6.8	6.8	183.5	182.2	182.3	14.1	14.1	14.1	0.3	0.3	0.3
21	38.6	0.1	0.1	0.1	0.4	0.4	0.4	13.2	11.7	12.4	2.2	2.0	2.1	0.9	0.9	0.9
22	9.6	0.3	0.3	0.3	1.5	1.5	1.4	46.6	41.5	43.9	7.8	7.1	7.4	3.4	3.4	3.4

TABLE 20 SUMMARY OF AIR POLLUTANT EMISSIONS FROM ALL SOURCES (cont.)

Grid	Land Area (Sq. Mi.)	SOx			PART.			CO			HC			NOx		
		S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
23	9.6	0.3	0.3	0.3	1.3	0.9	1.0	11.1	10.1	10.6	4.1	3.9	4.0	21.2	11.0	13.3
24	9.6	0.1	0.1	0.1	0.5	0.5	0.5	17.1	15.2	16.1	2.8	2.6	2.7	1.2	1.2	1.2
25	9.6	10.2	10.2	10.2	0.3	0.3	0.3	9.6	8.6	9.1	1.6	1.5	1.5	0.7	0.8	0.7
26	38.6	0.2	0.2	0.2	0.1	0.1	0.1	2.2	1.9	2.0	0.4	0.3	0.4	0.2	0.2	0.2
27	38.6	0.1	0.0	0.1	1.6	0.9	1.0	2.5	2.2	2.3	0.5	0.4	0.4	39.6	19.9	24.5
28	9.6	0.0	0.0	0.0	0.1	0.1	0.1	2.7	2.4	2.5	0.5	0.5	0.5	0.2	0.2	0.2
29	9.6	2.9	2.9	2.9	0.6	0.6	0.6	30.8	29.1	29.9	19.1	17.8	17.9	26.7	26.8	26.7
30	9.6	0.0	0.0	0.0	0.1	0.1	0.1	3.1	2.8	3.0	0.5	0.5	0.5	0.2	0.2	0.2
31	38.6	0.0	0.0	0.0	0.1	0.1	0.1	1.8	1.6	1.7	0.3	0.3	0.3	0.1	0.1	0.1
32	154.4	0.0	0.0	0.0	0.1	0.1	0.1	2.7	2.4	2.6	0.4	0.4	0.4	0.2	0.2	0.2
33	154.4	0.0	0.0	0.0	0.2	0.2	0.2	3.8	3.4	3.6	0.7	0.6	0.6	0.4	0.4	0.4
34	9.6	0.1	0.1	0.1	0.2	0.2	0.2	5.9	5.2	5.5	36.8	36.7	36.8	0.5	0.5	0.5
35	9.6	22.0	22.0	22.0	3.8	3.8	3.8	20.2	18.9	19.5	53.5	53.4	53.4	11.0	11.0	11.0
36	9.6	0.4	0.4	0.4	0.0	0.0	0.0	0.9	0.8	0.9	8.4	8.4	8.4	0.1	0.2	0.1
37	9.6	0.3	0.3	0.3	1.4	1.4	1.4	7.8	7.7	7.8	2.6	2.6	2.6	1.0	1.0	1.0
38	9.6	0.2	0.2	0.2	0.4	0.4	0.4	20.4	19.4	19.9	17.2	17.1	17.1	1.9	1.9	1.9
39	9.6	0.1	0.1	0.1	0.3	0.3	0.3	8.9	7.9	8.4	1.5	1.4	1.4	0.7	0.7	0.7
40	9.6	60.5	60.5	60.5	1.9	1.9	1.9	513.0	510.3	511.5	18.1	17.8	17.9	4.2	4.2	4.2
41	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.1	0.1	0.1	0.0	0.0	0.0
42	9.6	0.0	0.0	0.0	0.1	0.1	0.1	2.7	2.4	2.6	0.5	0.5	0.5	0.3	0.3	0.3
43	9.6	153.2	153.2	153.2	6.2	6.2	6.2	595.0	592.3	593.5	45.2	44.9	45.0	19.6	19.6	19.5
44	9.6	0.2	0.2	0.2	0.8	0.9	0.8	30.2	26.9	28.4	4.9	4.5	4.7	2.0	2.0	2.0

TABLE 20 SUMMARY OF AIR POLLUTANT EMISSIONS FROM ALL SOURCES (cont.)

Grid	Land Area (Sq. Mi.)	SOx			PART.			CO			HC			NOx		
		S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
45	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.1	0.1	0.1	0.0	0.0	0.0
46	9.6	85.8	85.8	85.8	25.1	25.1	25.1	12.9	11.5	12.2	279.0	278.8	278.9	5.0	5.0	5.0
47	9.6	0.3	0.3	0.3	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.1	0.1	0.1

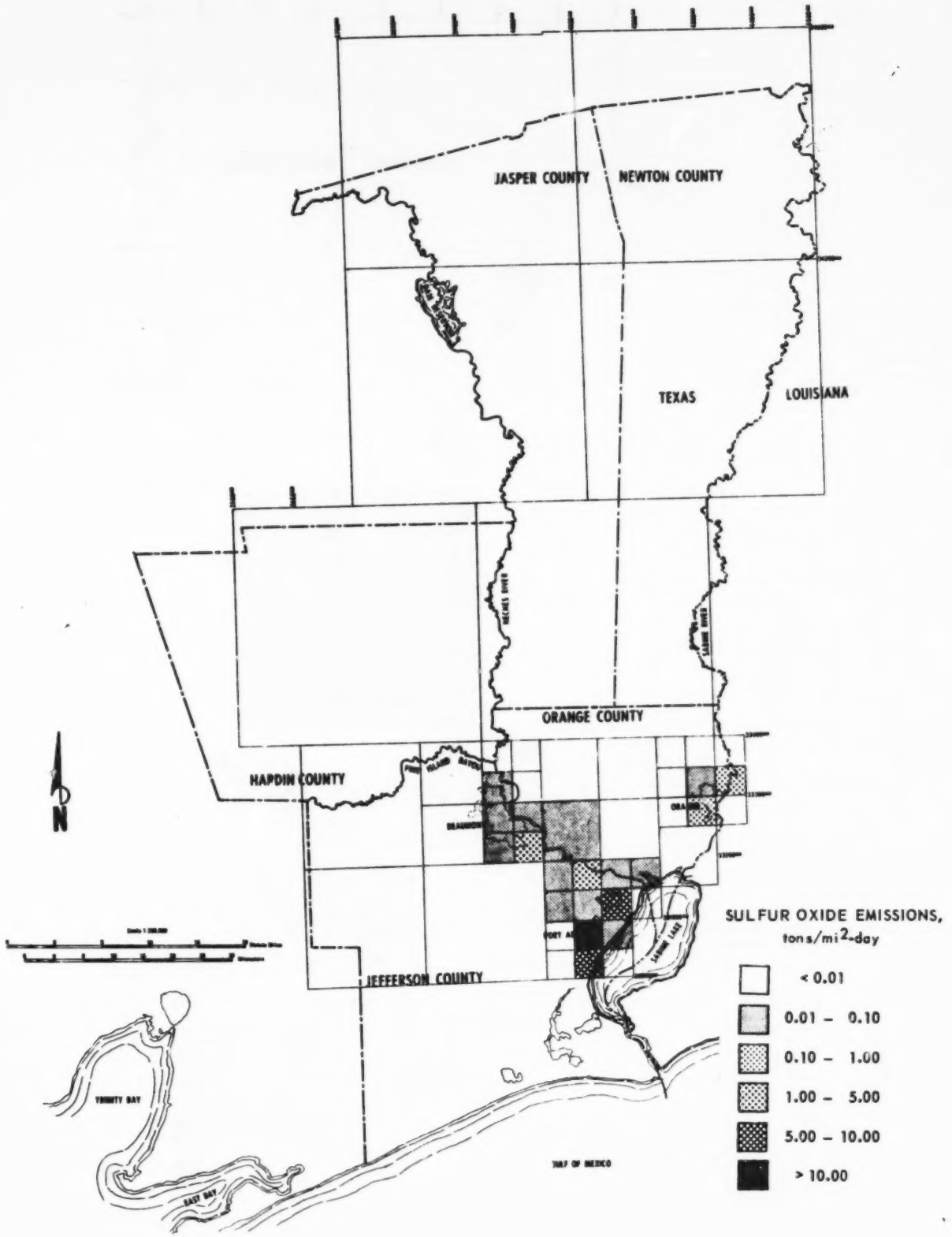

Figure 6. Sulfur oxide emission density map for Beaumont-Port Arthur study area, 1968.

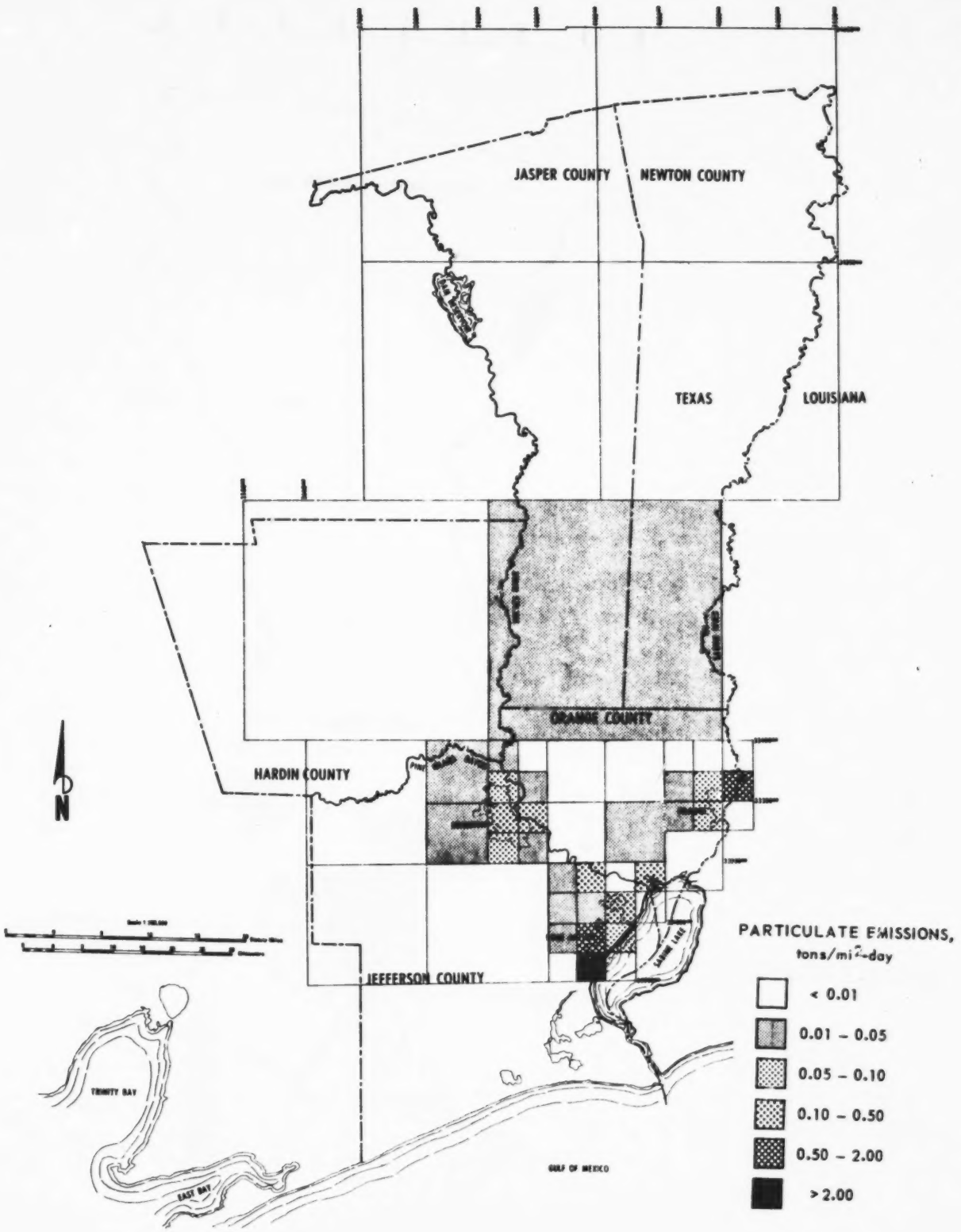

Figure 7. Particulate emission density map for Beaumont-Port Arthur study area, 1968.

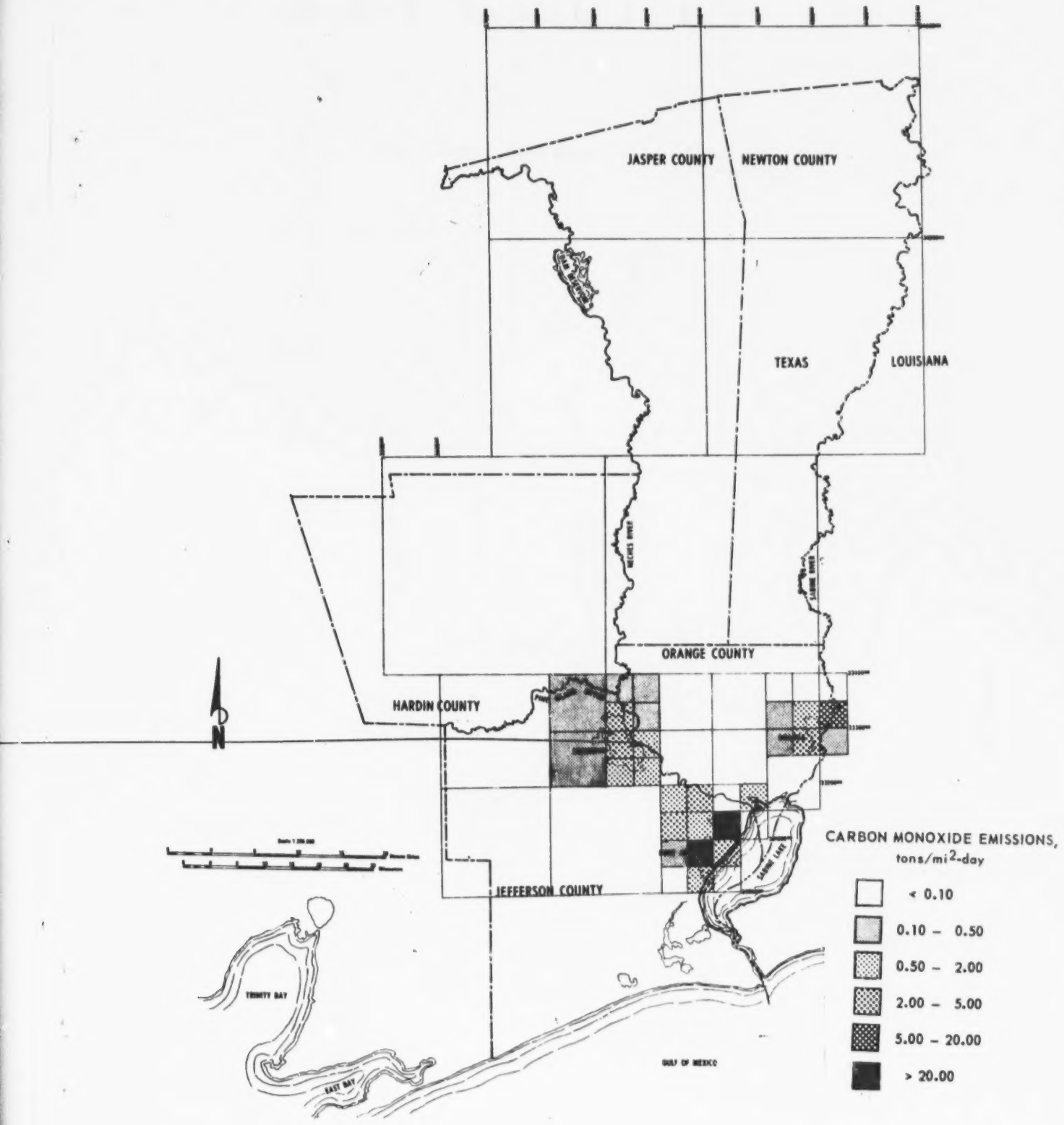

Figure 8. Carbon monoxide emission density map for Beaumont-Port Arthur study area, 1968.

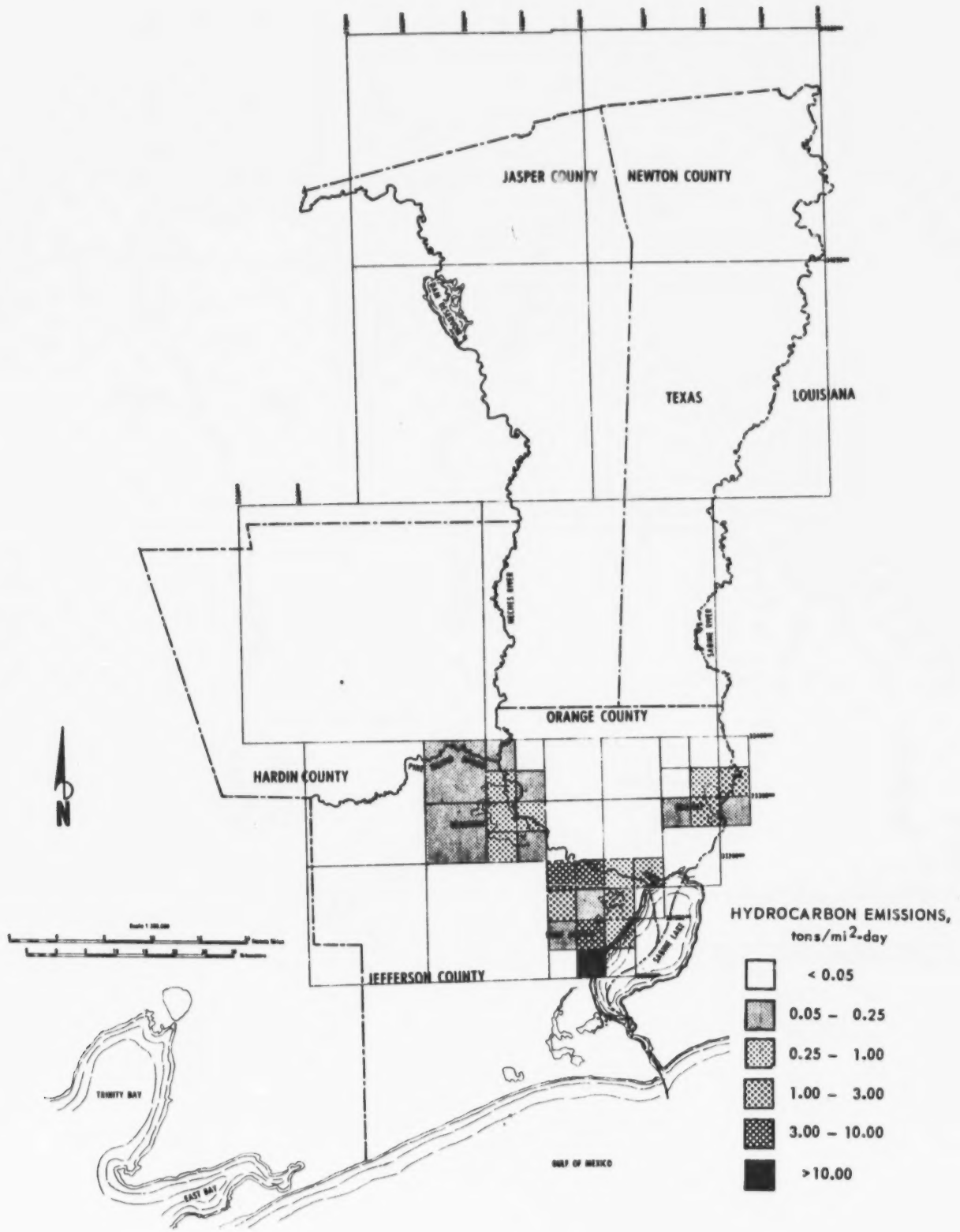

Figure 9. Hydrocarbon emission density map for Beaumont-Port Arthur study area, 1968.

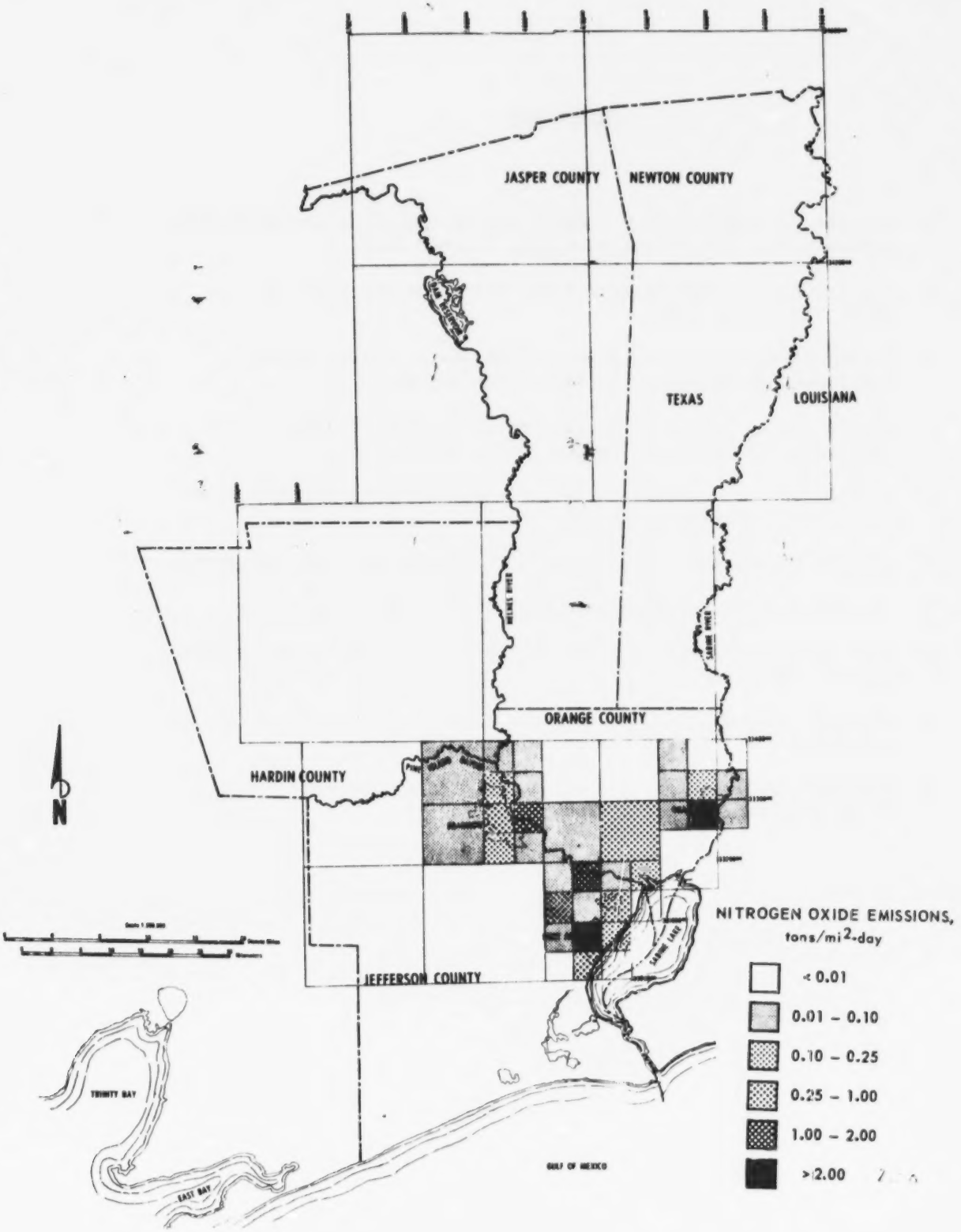

Figure 10. Nitrogen oxide emission density map for Beaumont–Port Arthur study area, 1969.

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